CLAIMS

We claim:

1. A method for automatically generating a fully-textured 3D model of an object; said method comprising:

receiving from a camera a sequence of images taken sequentially and respectively around the object;

generating a 3D region from a sequence of mask images; each of said mask images derived from one of said sequence of images;

generating a mesh model from said 3D region using a tree structure; and

producing said fully-textured 3D model from said mesh model with respect to said sequence of images.

2. The method as recited in claim 1 further comprising:

receiving a reference image captured when a calibration target is in the place of said object; and

deriving a camera model of said camera from said reference image.

3. The method as recited in claim 2, wherein said calibration target is of round shape and has a center thereof, and wherein said reference image covers only a portion of said calibration target, said portion including said center.

4. The method as recited in claim 3, wherein said deriving a camera model comprises:

detecting said center from said reference image and a pair of end points having a maximum distance, horizontally and vertically, respectively, from said center; and

calculating a major axis and a minor axis extending from said center to said pair of end points, respectively.

5. The method as recited in claim 1, wherein said generating a 3D region comprises:

utilizing cubes representing said object; and

carving said cubes recursively to fit said object by projecting said cubes against each of said mask images.

6. The method as recited in claim 5; wherein each of said cubes is encoded as a node in said tree structure that grows, while said carving said cubes recursively proceeds, till a predefined degree of refinement.

7. The method as recited in claim 6; wherein said generating a mesh model comprises:

collecting all leaves of said tree structure by traversing said tree structure,

determining boundary cubes from said leaves; and

triangulating a group of at least three of said boundary cubes according to predefined rules.

8. The method as recited in claim 7, wherein said mesh model is described by a plurality of triangles, each connecting three of said boundary cubes.

9. The method as recited in claim 8, wherein said producing said fully-textured 3D model comprises:

assigning each of said triangles to one of said images according to a normal of said each of said triangles; and

texturing said each of said triangles with respect to said one of said images.

10. The method as recited in claim 8, wherein said producing said fully-textured 3D model comprises:

growing patches respectively by adding each of said triangles to one of said patches when said each of said triangles shares at least one edge with entered triangles in said one of said patches; and

providing said patches for editing by a user using an image editing application.

11. The method as recited in claim 1, wherein said object is placed on a routable platform so that said sequence of images are taken when said object is rotated.

12. The method as recited in claim 11, wherein said routable platform is driven by a stepper motor controlled by a computing device that synchronizes said camera so that each of said images is taken at a known position.

13. The method as recited in claim 1; wherein said sequence of images are taken when said camera is moved around said object.

14. The method as recited in claim 13; wherein each of said images is taken at a known position by said camera.

15. A method for automatically generating a fully-textured 3D model of an object; said method comprising:

receiving from an camera a reference image of a portion of a calibration target having a center for deriving a camera model of said camera; said portion including said center;

detecting said center from said reference image and a pair of end points having a maximum distance, horizontally and vertically, respectively, from said center; and

calculating a major axis and a minor axis extending from said center to said pair of end points, respectively.

16. The method as recited in claim 15, further comprising:

receiving from said camera a sequence of images taken sequentially and respectively around the object; and

converting said sequence of images respectively and correspondingly to a sequence of mask images.

17. The method as recited in claim 16, further comprising:

generating a 3D region from said mask images;

generating a mesh model from said 3D region using a tree structure; and

producing said fully-textured 3D model from said mesh model with respect to said sequence of images along with said camera model.

18. A computer readable medium for storing computer program instructions for automatically generating a fully-textured 3D model of an object; said computer readable medium comprising:

first program code for receiving from a camera a sequence of images taken sequentially and respectively around the object;

second program code for generating a 3D region from a sequence of mask images; each of said mask images derived from one of said sequence of images;

third program code for generating a mesh model from said 3D region using a tree structure; and

fourth program code for producing said fully-textured 3D model from said mesh model with respect to said sequence of images.

19. The computer readable medium as recited in claim 18 further comprising:

fifth program code for receiving a reference image captured when a calibration target is in the place of said object; and

sixth program code for deriving a camera model of said camera from said reference image.

20. The computer readable medium as recited in claim 19, wherein said calibration target is of round shape and has a center thereof, and wherein said reference image covers only a portion of said calibration target, said portion including said center.

21. The computer readable medium as recited in claim 20, wherein said sixth program code comprises:

program code for detecting said center from said reference image and a pair of end points having a maximum distance, horizontally and vertically, respectively, from said center; and

program code for calculating a major axis and a minor axis extending from said center to said pair of end points, respectively.

22. The computer readable medium as recited in claim 18, wherein said second program code comprises:

program code for utilizing cubes representing said object; and

program code for carving said cubes recursively to fit said object by projecting said cubes against each of said mask images.

23. The computer readable medium as recited in claim 22; wherein each of said cubes is encoded as a node in said tree structure that grows till a predefined degree of refinement.

24. The computer readable medium as recited in claim 23; wherein said third program code comprises:

program code for collecting all leaves of said tree structure by traversing said tree structure,

program code for determining boundary cubes from said leaves; and

program code for triangulating a group of at least three of said boundary cubes according to predefined rules.

25. The computer readable medium as recited in claim 24, wherein said mesh model is described by a plurality of triangles, each connecting three of said boundary cubes.

26. The computer readable medium as recited in claim 25, wherein said fourth program code comprises:

program code for assigning each of said triangles to one of said images according to a normal of said each of said triangles; and

program code for texturing said each of said triangles with respect to said one of said images.

27. The computer readable medium as recited in claim 25, wherein said fourth program code comprises:

program code for growing patches respectively by adding each of said triangles to one of said patches when said each of said triangles shares exactly one edge with entered triangles in said one of said patches; and

program code for providing said patches for editing by a user using an image editing application.

28. The computer readable medium as recited in claim 18, wherein said object is placed on a routable platform so that said sequence of images are taken when said object is rotated.

29. The computer readable medium as recited in claim 28, wherein said routable platform is driven by a stepper motor controlled by a computing device that synchronizes said camera so that each of said images is taken at a known position.

30. The computer readable medium as recited in claim 18; wherein said sequence of images are taken when said camera is moved around said object.

31. The computer readable medium as recited in claim 30; wherein each of said images is taken at a known position by said camera.

32. A computer readable medium for automatically generating a fully-textured 3D model of an object; said computer readable medium comprising:

program code for receiving from an camera a reference image of a portion of a calibration target having a center for deriving a camera model of said camera; said portion including said center;

program code detecting said center from said reference image and a pair of end points having a maximum distance, horizontally and vertically, respectively, from said center; and

program code calculating a major axis and a minor axis extending from said center to said pair of end points, respectively.

33. The computer readable medium as recited in claim 32, further comprising:

program code for receiving from said camera a sequence of images taken sequentially and respectively around the object; and

program code for converting said sequence of images respectively and correspondingly to a sequence of mask images.

34. The computer readable medium as recited in claim 33, further comprising:

program code for generating a 3D region from said mask images;

program code for generating a mesh model from said 3D region using a tree structure; and

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program code for producing said fully-textured 3D model from said mesh model with respect to said sequence of images along with said camera model.

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35. A system for automatically generating a fully-textured 3D model of an object; said system comprising:

a turntable driven by a stepper motor to rotate said object placed thereon;

a camera positioned within a field of view of said camera viewing from an angle • looking down toward, and slightly oblique to said turntable;

a computing device including memory loaded with program code, said computing device coupled to and synchronizing said camera and said stepper motor, said computing device caused, when said program is executed therein, to perform operations of:

receiving from said camera a sequence of images taken sequentially and respectively of said object when said object is being rotated by said stepper motor;

generating a 3D region from a sequence of mask images; each of said mask images derived from one of said sequence of images;

generating a mesh model from said 3D region using a tree structure; and

producing said fully-textured 3D model from said mesh model with respect to said sequence of images.

36. The system as recited in claim 35, wherein said memory is further loaded with an image processing application.

37. The system as recited in claim 36, wherein said producing said fully-textured 3D model comprises:

generating textured patches covering said object; and

exporting said textured patches to said image processing application for being edited and modified by a user.

38. The method as recited in claim 37, wherein said producing said fully-textured 3D model further comprises:

combining said edited and modified textured patches to represent said fully-textured 3D model in a desired manner by the user.